Deep Learning-Based Image Semantic Coding for Semantic Communications

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Abstract

This paper presents the Generative Adversarial Networks (GANs)-based image semantic coding, the goal of which is semantic exchange rather than symbol transmission. State-of-the-art visually pleasing reconstruction and semantic preserving performance are obtained in extreme low bitrate via a rate-perception-distortion optimization framework. In particular, we investigate convolutional encoder, quantizer, conditional SPADE generator, residual coding as well as perceptual losses. In contrast to previous work, we designed a coarse-to-fine image semantic coding model for multimedia semantic communication system. The base layer of the image is fully generated and preserves semantic information while the enhancement layer restores the fine details. We explore the perception and distortion performance trade-off by tuning the rate of base layer and enhancement layer. Different from the existing methods that adopt pixel accuracy as distortion metric, we train and evaluate the proposed image semantic coding model with multiple perception metrics, in line with the purpose of semantic communications. Experimental results demonstrate that our model could achieve visually pleasant and semantic consistent reconstruction, as well as saving times of bitrate, compared to BPG, WebP, JPEG2000, JPEG, and other deep learning-based image codecs.